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Record of a 50-year-old Apple Orchard

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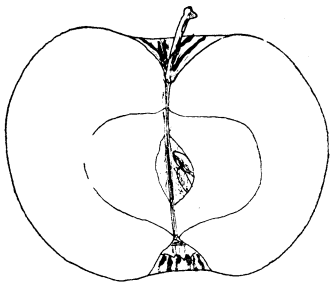
CONTENTS

Site 3
Regularity of Production 4
Frost Damage 4
Hail 4
Mortality of Trees in Orchard 4
Winter Injury 5
Mice Injury 5
Fire Blight 5
Soil Management of Orchard 6
The Mulch 6
Cost of Mulch 6
Working Conditions in Orchard 7
Changing from Mulch to Cultivation 7
Use of Fertilizers 7
Soil Moisture under Mulch 7
Frost Penetration 8
Depth of Root Penetration 8
Pruning 9
Size of Trees 9
Scaffold Branches 10
Top-grafting Experience 10
Cost of Operation 11
Spraying Machinery and Materials Used 11
Time Required for Spraying 12
Time Required to Pick Apples 13
Quality of Fruit 13
Color of Fruit 13
Size of Fruit 14
Variety Production Records for Thirty-three Years 14
Yield per Acre 17
Experience in Planting Replacement Trees 18
Experience in Transplanting Four-Year-Old Stayman Winesap Trees 19
Removal of Orchard A 19
Summary 20
Literature Cited 21

Description of tree: Description Blank—Apples. Ohio Experiment Station

Tree medium size, with rounding top symmetrical; upright when young but with fruit bearing tree becomes spreading. Branches and twigs slender, willowy. Twigs light brown. Leaves medium size, light green. Produces annual crops.
Description from tree O S 16



Description of fruit:

Size medium to large. Form rounding oblate, slightly inclined to conical. Stem medium length and slender, 3/4 inches. Cavity wide, deep, acummate. Sometimes russetted. Calyx medium size. Closed or partly open, lobes short, green. Basin rather deep, medium width, abrupt, slightly furrowed, pubescent around calyx. Skin bright crimson, glossy, some grayish bloom, takes polish readily, dots prominent, grayish. Seed medium to large, dark brown, pointed, acute. Flesh creamy white, fine grained. When apples were described they had become mealy, possibly due to having been in warm room seveal days. Quality good. Season apparently midwinter.

A very hightly colored apple sent to Station by E. J. Riggs. Raccoon Island, Ohio. Having originated in Gallia County. Probably would be better for northern Ohio than its parent Rome Beauty.

Gallia Beauty. 1918
CWE.

Orchard A
16

Form used in recording descriptions of apple varieties tested in Orchard A.

RECORD OF A 50-YEAR-OLD APPLE ORCHARD

C. W. ELLENWOOD AND T. E. FOWLER

Orchard A at the Ohio Agricultural Experiment Station was planted in the spring of 1893. During the winter months of 1942-43, this orchard was removed. This publication is, therefore, a report covering the 50-year history of this apple orchard.

The data hereafter submitted are thought to be of value from the standpoint of variety comparison. They also indicate what may be expected in the way of production when the grass-mulch system of soil management is followed for a long period of years. The importance of selecting a suitable site for an orchard is also demonstrated by the data presented.

In 1893, when this orchard was planted, the chief interest of the orchardist was in varieties. Accordingly, the orchard was primarily designed for variety trials.

Approximately 100 varieties, with from three to seven trees of each variety, were included in the orchard. The permanent trees were set in squares 33 feet apart. The orchard consisted of 11 permanent rows of 25 trees each. Originally a filler tree was set midway between the permanent trees in the tree rows, but these filler trees had all been removed by 1908. The orchard covered an area of approximately 7 acres; however, a small section of about three-tenths of an acre was removed early in the history of the orchard to make room for water reservoirs. The soil was Wooster silt loam.

SITE

The site selected for the orchard was at the highest elevation on the Experiment Station Farm. The highest point was approximately 1100 feet above sea level and from this point the land sloped gently in all directions. The lowest point in the orchard is not more than 25 feet lower than the highest. Beyond the orchard towards the north there is a gentle slope extending for a mile; then there is a more abrupt slope towards the Apple Creek Valley about 200 feet lower than the orchard. Westward from the orchard for somewhat less than a mile the slope is gradual and then the land drops away rather steeply towards the Killbuck Valley. Eastward from the orchard the land continues comparatively level for several miles. Towards the south, the slope is rather gentle for 3 miles or more. This orchard site proved to have good air drainage. Thermometer readings taken from a U. S. Weather Bureau thermometer nearby have generally shown an average minimum temperature during April and May of about 2 degrees higher than those from a similar thermometer a mile away at an elevation of 1030 feet. The advantage of the site is further attested by the regularity of the crops. Detailed individual tree records of production were kept beginning with 1910 and continuing until the trees were finally removed.

REGULARITY OF PRODUCTION

Regularity of production from year to year determines the value of any site for an orchard. It is not enough to have a high average annual production over a 10- or 20-year period; the production must be reasonably even from year to year. The inherent characteristics of certain varieties to be biennial in production of course cannot be overcome by choice of site. It has been shown (1) that low yields induced by spring frosts present one of the principal reasons for the great fluctuation in the annual apple production in Ohio.

FROST DAMAGE

Orchard A was singularly free from frost injury during the 50-year period. During the 33-year period (1910-1942) through which individual tree records were taken, there were only 3 years (1910, 1928, and 1938) when spring frost was a factor in reducing yields in this orchard. However, even in these years a fair crop was produced. The total production in the orchard did tend toward heavy and medium crops in alternate years, but this variability was due mainly to the biennial habit of bearing of many of the varieties.

HAIL

Hail sometimes causes very serious damage in Ohio orchards. The degree of damage varies with the time of year when the hail occurs. Hail storms during the growing season in the area of Wooster are most common in the late summer months and it is then that fruit may suffer the most from such injury. It is interesting to note that during the 50-year period herein discussed hail did not cause serious damage in this orchard more than twice. In one of these 2 years, two hail storms occurring during an interval of only a few weeks caused a considerable amount of injury but the actual degree of damage was not determined.

By recording the frequency in which hail occurred in this particular orchard, it is not intended that this experience shall be used as a basis for estimating probable hail loss. Hail is one of the hazards in growing fruit and has to be reckoned with in all sections of the State.

MORTALITY OF TREES IN ORCHARD

In the original planting of Orchard A, there were 266 permanent trees. At the end of 1942, 145 of these original trees were still standing; in addition, there were 104 trees which had been planted as replacements from 1909 to 1937, inclusive, so that the orchard embraced a total of 249 trees when it was removed. As has been stated, this orchard was set primarily for testing varieties and some of the original trees were removed after the variety had been tested and proved inferior. Other trees were top worked to one or more varieties. The yield record of 107 of the original trees which had not been modified by top-grafting is presented in table 6.

The mortality of the trees during the life of the orchard could be rated as very low.

WINTER INJURY

During at least two winters there was a considerable amount of damage in this orchard from winter injury.

The first serious winter injury was noted in 1915. This injury was manifested by a loosening of the bark at the base of the tree. While the injury which occurred this year doubtless weakened several trees in the orchard, none was completely killed. Some of the scars could be seen 27 years later when the trees were removed. Damage to the crotches of the trees often associated with winter injury was not as prevalent after the winter of 1915 as it was following the winter of 1935-36.

During the winter of 1935-36 there were 16 sub-zero days recorded during December, January, and February. This prolonged cold winter followed an autumn of slightly above average rainfall.

Many varieties in Orchard A were quite seriously damaged along the trunk from the ground to the lower lateral branches. There was also a considerable amount of damage in the crotches of the main limbs extending along the limbs from 12 to 18 inches from the crotch. Of the better known varieties, Baldwin and Stayman Winesap suffered the most serious damage. Some other varieties, such as Ralls, Salome, and Ohio Nonpareil, were even more seriously injured. A few trees were killed as the result of this injury. These old trees were in their forty-third year and recovery in many instances was slow and in others there was a gradual decline in vigor from this year.

MICE INJURY

During the earlier years of the orchard, it was the annual practice to clear the litter away from the base of the trees in order to avoid danger from mice injury. Coal cinders were also applied around the base of each tree.

The most serious mice injury occurred during the autumn and winter period of 1938-39. The injury in this heavily mulched orchard was less serious than in one of the cultivated orchards on the Station Farm. Five trees in the entire orchard were injured by mice during this period. One of them, even though it was then 45 years old, was almost completely girdled and required bridge grafting. On the whole, the damage from mice in this mulched orchard was very low, although no poison bait was used. Natural wild predators and cats and dogs from nearby farm homes doubtless helped to keep down the mice population in the orchard.

FIRE BLIGHT

Fire blight occurred on the blight-susceptible varieties in serious proportions in this orchard several years. The usual sanitary measures, such as cutting out the blight and treating the cankers with antiseptic washes, were resorted to with the more seriously blighted trees on several occasions. Observations were made on the prevalence of blight in this orchard as compared with trees grown under cultivation. Trees of equal vigor and of the same variety did not blight more seriously in this mulched orchard than in cultivated ones.

SOIL MANAGEMENT OF ORCHARD

For the first 6 years after planting, the orchard was cultivated. At the end of the 6 years, the orchard was seeded and from then until it was removed, 44 and 45 years later, it remained in sod and was mulched. The sod was predominantly bluegrass. The regular practice was to mow the orchard twice each year, in early June and again in August, in order to facilitate spraying and the removal of the fruit. In one or two exceptionally dry seasons, the August mowing was omitted. The tonnage of grass in the last 15 years was very light, due to the shading and the large area covered by the mulch.

THE MULCH

A heavy mulch was maintained around each tree, extending outward as far as the branches and to within 3 or 4 feet of the trunk of the tree. Insofar as possible, waste materials were used for mulching. These materials included straw from old straw stacks, weedy hay and hay which had been spoiled by rain, corn fodder, sweetclover grown too large for feed, soybean haulm, some corn cobs, and several other materials. The mulch was applied at any time of the year when time and material were available. Weights were not always available, so no record was kept of the total amounts applied. A sufficient covering was maintained around each tree to discourage the growth of grass in the mulched area. It was the practice to mulch each tree rather heavily at least once in 2 years. This practice of mulching was carried on for a period of 44 years, and it seems likely that this is a longer period than has ever been previously reported of a mulched orchard.

The orchard was not so designed that comparative plots of other types of soil management were available for observation. The yield records as shown in table 6 and the all around behavior of the orchard do demonstrate that the system of soil management used gave good results.

COST OF MULCH

Cost of maintaining a mulch in an orchard depends upon several factors, such as cost of material, thickness of the layer of mulch, and the cost of applying it. No cost records are available for this particular orchard. Much of the mulch used throughout the life of the orchard was waste material and the cost merely involved hauling it to the orchard, distances of a mile or less, and the labor of spreading it under the trees.

The experience in this orchard and in other nearby mulched orchards demonstrates that after an orchard planted as close as this one reaches 20 years of age, very little mulch material can be grown in the orchard. In fact, by mowing the grass twice each year, it was often not necessary to rake it up at all.

The labor required to spread the mulch depends upon the material used. Loose straw or similar material is rather quickly distributed about the tree, while baled straw or corn fodder require nearly twice as long to spread.

It is not claimed here that mulching is cheaper than cultivation; in fact, where mulching is as thoroughly practiced as it was in this orchard, the expense will generally be greater than for cultivation.

WORKING CONDITIONS IN ORCHARD

Windfalls under well mulched trees are of much better quality than those from trees growing in cultivation. There are fewer bruises and the apples are cleaner.

Perhaps even more important than the quality of the windfalls is the advantage of moving equipment through the mulched orchard more easily than is possible in an orchard under cultivation. This is especially true in the spring when much of the spraying is done and the ground is frequently wet.

CHANGING FROM MULCH TO CULTIVATION

About 15 years before the trees were removed, one section of the orchard, embracing two spaces between tree rows, was plowed, and from that time forward, this area of the orchard was cultivated annually.

One of the reasons for setting up this demonstration was that clean cultivation had been suggested as the best means of controlling the apple flea weevil which had made its appearance in the orchard. A short time later, a successful spray program was developed for the control of this insect, but the plot was continued under cultivation to note the effect on tree behavior.

No effect on the trees, either good or bad, was observed following the change in systems of soil management.

USE OF FERTILIZERS

For the first 35 years no commercial fertilizer was applied to this orchard. Beginning 15 years before the orchard was removed, some nitrogen fertilizer, such as sulfate of ammonia and nitrate of soda, were applied to some sections of the orchard. The addition of the fertilizer made no appreciable difference insofar as yield and size or color of fruit were concerned nor was there any notable effect on the vigor of the tree.

It seems safe to conclude that on this particular site the addition of commercial fertilizers to the mulch would not have benefitted this orchard materially.

SOIL MOISTURE UNDER MULCH

The long continued use of mulch in this orchard undoubtedly was an important factor in the conservation of moisture.

The availability of sufficient moisture for growth of trees and fruit even in dry years was quite noticeable throughout the life of the orchard.

Soil moisture determinations were not made annually, but sufficient observations were made during the very dry seasons to show the advantages of mulch under drouth conditions.

One of the driest years during the life of the orchard was 1930. The total rainfall at Wooster for the months of April, May, June, and July in 1930 was 8.39 inches. The long-time average (46 years) for these 4 months was 14.80 inches. During the early part of August 1930, moisture determinations were made of the soil under the mulch and also in the sod area between the trees, as well as from the section where the soil was in clean cultivation. The composite results of the several determinations are shown in table 1.

About the time the samples, as reported in table 1, were taken, some trees growing in an adjacent orchard in sod which was not mulched were showing signs of wilt. None of the trees growing in the mulched area of this orchard gave any evidence of wilting throughout the 50-year period.

TABLE 1.—Soil moisture in Orchard A, August 1930

	Mulch	Sod	Clean cultivation
	Pct.	*Pct.*	*Pct.*
Upper 6 inches of soil	10.45	6.16	7.48
Second 6 inches of soil	8.45	6.31	6.98
Average for 12 inches	9.45	6.24	7.23

FROST PENETRATION

Temperatures under mulched areas are more uniform than in cultivated areas. Observations were made of the depth of frost penetration at various locations several years during the life of the orchard. The results of some of these observations are given in table 2.

TABLE 2.—Depth of frost penetration under different soil management conditions

Treatment	Date of examination		
	March 3, 1934	Feb. 26, 1936	Feb. 28, 1942
	In.	*In.*	*In.*
Heavy straw mulch	3.0	9.0	2.0
Sod not mulched	9.5	18.0	3.0
Clean cultivation	14.3	30.0	9.0

No estimate of damage from root freezing was made, but it is apparent that the protection provided by the mulch would be of some value in preventing damage from this source. The examination of the soil was made before any thawing had taken place and as nearly as possible at the end of freezing weather; hence, the figures shown in table 2 probably represent maximum frost penetration for the season. The winters of 1933-34 and 1935-36 were colder than average, while that of 1941-42 was relatively mild.

DEPTH OF ROOT PENETRATION

Rather extensive observations were made relative to the distribution of tree roots in the orchard and some of the data thus accumulated have been previously reported (5); only brief reference will be made to the matter here. The observations showed that the roots were rather well distributed for a depth of 5 or 6 feet, with more than 60 per cent of the total within 2 feet of the surface.

The nature of the soil was conducive to deep rooting; there was no evidence that mulching tended to encourage shallow rooting.

The fact that these trees were rather deeply rooted undoubtedly was a major factor in the longevity of the life of this orchard. A large portion of the trees were still in a highly vigorous condition when they were removed;

however, the type of tree training followed during the early history of the orchard and the aftermath of severe freezing during one or two winters did result in some decay. Nevertheless, when most of the trees were removed, it required a heavy charge of dynamite, as well as a considerable amount of energy by a tractor attached to block and tackle to pull them clear of the ground.

PRUNING

Records of the type of pruning practiced in this orchard during the early years are not available.

Some time prior to 1910 the centers of the trees were removed so that they were pretty generally open-centered trees. Between 1910 and 1920 an effort was made to change the structure of the trees into modified central-leader trees; in some cases, this was occomplished by selecting a lateral limb with a tendency to grow towards the center.

On the trees where it was possible to develop some semblance of a central leader a stronger structure was developed, but most of the trees throughout the orchard continued to have strong tendencies towards the open-headed type. The structure of the trees were such that it was necessary to use a large amount of cable and wire bracing to keep them from splitting under the pressure of heavy loads of fruit. Between the thirty-fifth and fiftieth years, there was a considerable amount of breakage, as well as some decay, in the trunks because of the earlier removal of the central leader. Experience in handling this orchard would not justify a recommendation of the early training given these trees. However, it should be noted that the yield records over a long period of years demonstrated that in spite of the type of early training these trees were on the whole very productive. Cost of the pruning operations, due to the bracing required, was undoubtedly more than it would have been had a modified-leader type of training been practiced from the beginning.

The overall long time experience with the trees in this orchard demonstrated that there is a natural tendency for an apple tree to compensate for the removal of the central leader by one or more of the lateral branches filling in the center.

A light annual pruning of this orchard, consisting of the removal of the weaker growth and interfering branches, was practiced during the last 30 years. The amount of detailed thinning varied with the variety.

When the trees were between 35 and 37 years old, a considerable amount of heading back was done to keep the height of the trees with the range of 20- to 25-foot picking-ladders. This heading back in some cases resulted in heavy growth of water sprouts which necessitated additional pruning work. Because of the rather short planting distance (33 feet by 33 feet), a considerable amount of restrictive pruning of the lateral growth was necessary to permit the passage of sprayers and other equipment between the trees.

SIZE OF TREES

Measurements were made at different intervals in the life of this orchard to ascertain the size of the trees. As has been stated elsewhere, the trees made vigorous growth, particularly during the early years. By the time the orchard was 25 years old, in many cases the diameters of the heads of the trees were occupying the full space between trees (33 feet).

In table 3 the spread of the branches of some of the well known varieties is shown at 31 years from planting. It will be noted that by the time the orchard was 31 years old, many of the varieties were large enough that their top branches were interlacing with the tops of adjacent trees.

TABLE 3.—Comparative size of trees before restrictive pruning

Variety	Diameter of head of tree 31 years from planting	Variety	Diameter of head of tree 31 years from planting
	Ft.		*Ft.*
Wealthy	25.7	Jonathan	31.2
Winesap	29.5	Baldwin	34.4
Grimes Golden	30.7	Northern Spy	37.0
Rome Beauty	31.0	Rhode Island	42.2

This orchard demonstrates clearly that, on similar soil and under like cultural treatment, at from 30 to 35 years of age most apple varieties can be expected to fill the space between trees when the planting distances are 33 to 35 feet apart. This means that from this time until the orchard is removed, restrictive pruning will be required.

When this orchard was removed at the end of 50 years measurements of the diameter of the trunks were made 12 inches above the ground. Wealthy trees were only 14 inches in diameter; whereas some of the large-growing varieties, like Baldwin and Rhode Island Greening, had trunks 27 inches in diameter. The average diameter of the trunks of these 50-year-old trees was 20.7 inches.

SCAFFOLD BRANCHES

Although the early training of this orchard, as has been pointed out, was rather severe, the trees developed into well-shaped and fairly uniform trees of good size.

When the trees were 37 years old, a study was made of the tree structures to determine the number of scaffold branches on the normal trees of several varieties. The results of this study on six varieties are shown in table 4. It will be noted that the number of scaffold branches on these 37-year-old trees did not vary to any great degree between varieties.

TABLE 4.—Main scaffold branches on 35-year-old apple trees

Variety	Number of main scaffold branches per tree	Variety	Number of main scaffold branches per tree
Baldwin	10	McIntosh	9
Delicious	9	Northern Spy	9
Grimes Golden	8	Stayman Winesap	9

TOP-GRAFTING EXPERIENCE

Throughout the life of this orchard, varieties which proved inferior were frequently top-worked to other varieties. In some cases several varieties were grafted on a single tree. As the trees grew older, it was demonstrated that four varieties constituted about the maximum number which could be used with satisfactory results in top-working, even for variety testing. When more

than four varieties were used, there was apt to be shading of some of them and the fruit on such branches could not be considered normal. This experience suggests that the present limited practice of planting multiple trees (that is, trees with two or more varieties worked on scaffold branches) should be limited to four varieties. Several hundred top grafts were set in this orchard when the trees were from 11 to 13 years old. Only those grafts located towards the tops and outer extremities of the trees could be rated as having been successful. Scions set in the interior of the tree made little growth at the outset and a high percentage of them died; furthermore, others were accidentally removed in pruning. Most of the top-working was done by means of cleft-grafting, although some whip-grafting and side-grafting were used successfully.

During the years 1912 and 1913, there was an epidemic of fire blight on some of the blight-susceptible varieties in this orchard; hence, in 1914, when the trees were in their twenty-first year, some of the most susceptible varieties were top worked to varieties less susceptible to blight. Although Tolman Sweet had blighted very seriously, it proved to be a good understock for such varieties as Delicious and Grimes, even though the trees were well past the age when top-grafting is generally done. Ten years after these Tolman trees were top-worked, mainly by cleft-grafting, the point of union was hardly discernible.

COST OF OPERATION

It is a well known fact that many of the items of cost of operating an orchard increase materially as the trees get larger and older.

Such operations as pruning, spraying, thinning, and harvesting may be expected to cost more per bushel of fruit on 42- to 50-year-old trees than on trees from 10 to 25 or 30 years of age.

Naturally, the cost of some of these items, particularly pruning and thinning, depends in a large measure upon the thoroughness which the grower considers necessary for his particular varieties and market conditions. If an annual detailed pruning is given the older trees, the expense will be considerably greater than if bulk or thin-wood pruning is practiced or if very light pruning is the rule. There is no question but what the cost of pruning on a per-bushel basis is much greater on the older trees than it is on trees from 10 to 30 years old.

Thinning costs vary with the variety, the type of pruning, and, of course, the set of fruit in any particular year. Thinning the older trees in this orchard on varieties such as Transparent, Grimes, and Jonathan was a laborious and expensive task. Unfortunately, the necessity for thinning these older trees of the relatively small-fruited varieties is greater than it is on younger trees.

Both pruning and thinning of these older trees require the use of long ladders which adds to the time required for the operation. The industrial hazard of working in the trees is also greater on older orchards.

SPRAYING MACHINERY AND MATERIALS USED

Throughout the life of this orchard whatever spray program seemed best designed to keep the trees healthy and the fruit free from insect and disease injury was followed. The materials used and the methods of application were radically different at the end of the period than they had been at the start.

The first spraying equipment used consisted of a small hand pump mounted on a barrel equipped with a bamboo spray rod. This was followed by a compressed-air power sprayer with a 100-gallon tank for the spray material and a companion tank for the air. This outfit was replaced by a single-cylinder gasoline-motor power sprayer having a capacity of 6 to 8 gallons per minute. Next came a single-cylinder sprayer of larger capacity in which the spray gun replaced the bamboo pole. Later still came the two-cylinder, 12- to 15-gallon-per-minute pump and then the four-cylinder, 35-gallon-per-minute outfit mounted on rubber tires. From 1893 to 1919 change in equipment came rather slowly, but from 1920 to the end of the life of this orchard many improvements were made in spraying equipment. Although the trees were large before they were removed and much material was required to cover them, efficient coverage could be accomplished by careful use of the high-powered equipment. Following the bamboo pole came the use of many types of spray guns including 2-, 4-, 6-, 8-, and 12-cluster brooms.

A limited amount of dusting was practiced in the orchard.

The spray materials used in this orchard during the 50-year period were a reflection of the evolution in the spray schedule during the period. At first Bordeaux mixture was the standard fungicide. This was followed by the self-boiled lime-sulfur formula commonly used from 1905 to 1910. Then came the use of commercial lime-sulfur, which remained the principal fungicide used. Some Paris green was used as an insecticide, but this soon gave way to lead arsenate which continued to be the principal insecticide used. Nicotine sulfate was used occasionally. In the late years, it was the regular practice to apply a dormant oil spray.

Thus, it will be seen that the life of this orchard covered the transition from crude spraying machinery to motorized high-pressure sprayers and also marked improvement in the character of the spray materials.

TIME REQUIRED FOR SPRAYING

The cost of spraying a tree of a given size depends on how much solution is required to cover the trees, although it is obvious that thorough spraying might require somewhat more time to discharge 100 gallons of solution on old trees than on smaller or medium-sized trees.

TABLE 5.—Relationships between size of apple trees and cost per bushel for spraying, 1934-1937

Age of trees	Average amount of solution per application per tree	Average yield	Cost of spraying per bushel
Yr.	*Gal.*	*Bu.*	*Ct.*
42-45	28.3	15.0	13
20-23	19.0	13.3	9
13-16	10.5	6.9	11

Over a 4-year period from 1934 to 1937, when costs were about average, observations were made in several of the Experiment Station orchards to establish the cost of spraying per bushel. The results of these observations are shown in table 5. The same spray solutions were used in each orchard and the same number of applications made to each orchard each year. Seven applications were made in 1934, 1935, and 1937, and eight applications in 1936.

It will be noted that the cost of spraying per bushel was lowest on the 20- to 23-year-old trees and greatest on the 42- to 45-year-old trees. The 13- to 16-year-old trees showed a cost per bushel for spraying midway between the other two groups.

TIME REQUIRED TO PICK APPLES

Some observations were made of the time required to pick apples in this old orchard, as contrasted with picking the same variety under similar condition from younger trees. The rate of picking 48-year-old trees bearing full crops of varieties like Stayman Winesap was 4.9 bushels per hour. The same crew picked 6.9 bushels per hour from 15-year-old trees and 6 bushels per hour from 25-year-old trees. Picking time on some of the varieties having large-growing trees, such as White Pippin, Northern Spy, and Rhode Island Greening, would be much slower than on varieties such as Stayman having moderate-sized trees. It seems safe to conclude that the rate of picking on trees 35 to 50 years old will be at least 2 bushels per hour slower than on 15- to 20-year-old trees.

QUALITY OF FRUIT

There is a generally accepted opinion among most Ohio fruit growers that the quality of the fruit borne on apple trees more than 35 years of age is not as good as that on younger trees.

Quality in this sense is usually determined by a definite measure of color and size. Less is known about the flavor of the fruit on these older trees as influenced by acid, sugar, and other factors, which go to determine the dessert and culinary acceptance of a variety. Some growers have reported that customers to whom they have sold fruit over a long period of years feel that the flavor and keeping quality of the apples from the older trees, as well as color and size, are not up to the standard that prevailed with fruit from the same trees earlier.

Where the number of older trees in the orchard acreage is exceeded by trees ranging from 10 to 25 or 30 years of age, this matter of quality of the fruit from the older trees may be relatively unimportant.

However, it is true that the percentage of fruit meeting the U. S. No. 1 grade or better will be less on these older trees.

COLOR OF FRUIT

For the last 15 years of the life of this 50-year-old orchard, the color on many of the varieties was not as good as it had been during the earlier years.

Part of this color deficiency could be charged to increased shading of the fruit-bearing area of the trees. It has been shown (2) that the poorly colored fruit comes from the interior and lower areas on mature trees.

While no extensive comparisons were made, throughout this period it was the general impression of the men working in the Station orchards that the fruit, even in the tops, of these old trees was not as well colored as fruit on the same varieties in nearby younger orchards.

In the case of some varieties which tended more and more towards poorer coloring, like Northern Spy and McIntosh, sun coloring the fruit (3) was used to good advantage. However, sun coloring adds to the expense of harvesting and storing and shortens the storage life of the fruit.

If sun-coloring was not used, it was necessary to spot-pick some varieties two or three times on these older trees in order to have a fair percentage of the fruit sufficiently colored to rate a U. S. No. 1 standard for color. While spot-picking apples two or three times is not an uncommon practice, it does add to the harvesting costs and whenever possible should be avoided.

The color of the fruit on the younger replant trees was satisfactory during the same years when color deficiency was noted on the older trees and the seasonal notes on this orchard up to about the thirty-fifth year do not indicate that poor color was a problem.

It can be asserted with certainty that the soil cultural methods used did not contribute to the color deficiency in the later years of this orchard. Lack of color was associated with the increasing age of the trees.

SIZE OF FRUIT

The records of the grading of the fruit were not taken in a way that would show the influence, if any, of the increasing age of the trees on the size of the fruit.

However, it was generally observed that in the case of some varieties which tend to average small or medium in size that the fruit produced in the later years was noticeably smaller than it had been earlier. This was especially true of such varieties as Yellow Transparent, Red June, Grimes, and Jonathan. On other varieties where the characteristic size is average or above, whatever reduction in size there may have been, due to increasing age of the trees, was not a serious matter. The 50-year-old trees of such varieties as Northern Spy, Baldwin, Rome Beauty, McIntosh, Delicious, Rhode Island Greening, and Stayman Winesap were still producing fruit of satisfactory sizes.

Just how much influence the soil management used in this orchard had to do with the maintenance of the production of fairly good sized apples cannot be determined with the data available. It was noted in years of extreme drouth that when apples in nearby unmulched grass orchards or orchards growing under cultivation tended to run small that the fruit of the same varieties in this orchard were more nearly normal in size except on the few small-fruited varieties previously mentioned.

VARIETY PRODUCTION RECORDS FOR THIRTY-THREE YEARS

The tree by tree yield records appear in table 6 for 107 trees planted in 1893, or within the next few years, which were not modified by top-grafting. There were 61 varieties represented in the 107 trees.

Accurate and detailed production records were first recorded in 1910; from that time until the orchard was removed, annual tree by tree yields were taken. The yields were recorded in bushels. In this case, bushel crates, holding on the average 48 pounds of apples, were used as a measuring unit.

The production records are shown in table 6. The data are presented in five separate periods: 1. For the first 10-year period (1910-1919), in which records were taken; 2. for the 20-year period (1910-1929); 3. the 30-year period (1910 to 1939); 4. for the last 4 years (1939 to 1942); and 5. finally, for the entire period of 1910 to 1942. This breakdown of the records shows the production trend within each variety. The average date of full bloom for

TABLE 6.—Bloom period and yield of apples

Average date of bloom and picking and yield per tree. Trees planted between 1893 and 1899. 33-year record, 1910-1942, inclusive

Tree No.	Variety	Average date		Average annual yield					Highest annual yield	Crop failures
		Full bloom	First picking	1910-1919	1910-1929	1910-1939	1939-1942	1910-1942		
				Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	
262	Arkansas	May 8	Oct. 26	13.0	12.0	16.0	22.6	16.4	42.5	4
264	Arkansas	May 8	Oct. 26	12.2	10.2	10.2	13.3	10.4	27.0	7
252	Arkansas Black	May 8	Oct. 28	12.6	13.5	12.6	22.0	13.4	46.4	0
301	Arkansas Black	May 8	Oct. 28	12.4	13.5	16.0	23.5	16.4	39.0	1
281	Astrachan	May 4	July 27	6.8	8.6	8.2	.....	.....	19.3	6
213	Babbitt	May 3	Oct. 11	11.7	15.4	19.6	31.2	20.8	46.0	0
299	Babbitt	May 3	Oct. 11	7.0	8.8	12.1	11.5	11.9	28.8	1
117	Baldwin	May 6	Oct. 15	14.7	14.3	13.4	7.4	12.7	36.0	6
118	Baldwin	May 6	Oct. 14	12.7	12.8	13.1	18.6	13.4	39.4	4
119	Baldwin	May 6	Oct. 14	18.3	17.4	16.7	13.3	16.4	35.7	2
126	Baldwin	May 7	Oct. 14	15.6	15.8	16.6	13.4	16.1	41.0	7
128	Baldwin	May 6	Oct. 14	12.9	14.4	15.8	14.7	15.1	44.8	5
85	Ben Davis	May 8	Nov. 1	12.3	12.9	14.5	23.2	15.5	37.0	4
87	Ben Davis	May 8	Nov. 1	16.4	17.4	16.6	10.2	16.1	46.6	2
394	Boiken	May 10	Oct. 15	12.1	16.3	13.0	.....	.....	46.0	3
106	Bottle Greening	May 7	Oct. 20	4.9	6.9	8.6	10.6	8.7	24.3	2
181	Celestia	May 8	Oct. 6	6.6	12.6	16.4	.....	.....	43.1	1
104	Centennial	May 9	Aug. 26	12.5	14.0	14.8	21.8	15.5	30.9	3
180	Charlamoff	May 7	Aug. 6	6.1	7.6	8.5	10.0	8.7	18.5	1
108	Collins	May 8	Oct. 29	5.0	6.0	8.9	12.3	9.1	26.5	2
105	Delicious	May 8	Oct. 9	7.8	9.2	11.6	16.4	12.3	35.5	1
102	Duling	May 6	Aug. 22	14.2	15.5	15.3	11.8	15.0	37.5	1
179	Early Harvest	May 6	July 20	8.7	9.0	8.8	.....	.....	37.0	1
268	Fallawater	May 8	Oct. 2	14.4	15.2	17.8	15.2	17.1	54.7	4
269	Fallawater	May 8	Oct. 2	19.6	18.0	18.7	17.1	18.2	40.8	0
330	Fall Jennetting	May 9	Sept. 3	8.7	8.0	7.1	2.2	6.7	20.8	14
331	Fall Jennetting	May 8	Sept. 4	8.4	10.5	9.5	6.3	9.2	27.1	7
332	Fall Jennetting	May 9	Sept. 4	8.2	10.0	9.6	7.4	9.5	22.2	3
355	Fanny	May 7	Aug. 13	4.5	7.3	8.4	11.1	8.3	23.5	12
148	Gano	May 8	Oct. 31	24.3	25.4	28.2	38.3	29.6	59.2	0
107	Gideon	May 6	Sept. 8	6.0	10.4	11.5	9.9	11.3	33.0	8
97	Giffin	May 8	Oct. 3	14.8	16.9	17.5	10.8	16.6	34.0	0
98	Giffin	May 8	Oct. 3	13.1	14.2	13.5	7.7	12.7	32.0	5
188	Golden Russet	May 6	Oct. 24	8.7	11.0	12.4	12.2	12.1	36.7	0
315	Greenville	May 8	Oct. 8	7.9	11.1	12.2	12.5	11.9	33.3	2
316	Greenville	May 8	Oct. 8	7.7	9.2	10.8	12.6	10.7	27.6	5
317	Greenville	May 8	Oct. 8	4.8	8.1	10.0	13.8	10.0	36.0	4
196	Grimes	May 6	Oct. 1	16.0	18.0	20.6	29.4	22.0	58.0	1
214	Jefferies	May 8	Sept. 1	8.5	8.6	8.6	5.8	8.2	25.9	15
243	Jonathan	May 8	Oct. 5	10.3	15.6	17.6	11.0	16.6	44.3	1
244	Jonathan	May 8	Oct. 6	8.1	12.6	15.5	15.1	15.0	45.7	2
248	Lankford	May 8	Oct. 28	7.3	8.9	10.2	8.9	10.3	27.0	3
250	Lankford	May 8	Oct. 29	5.9	6.9	8.2	6.6	8.2	26.0	7
199	Lansingburg	May 6	Oct. 31	10.5	12.4	15.6	15.7	15.8	40.5	3
283	Late Strawberry	May 6	Sept. 2	10.5	9.4	9.8	9.2	9.6	22.8	5
284	Late Strawberry	May 6	Sept. 2	12.3	13.2	14.0	.....	.....	33.7	2
151	Loy	May 9	Oct. 22	14.2	15.7	18.1	19.0	18.7	48.0	8
216	Mann	May 5	Oct. 26	11.3	16.4	17.5	18.2	17.0	49.5	5
293	Mann	May 5	Oct. 26	8.9	10.2	12.4	13.0	12.1	38.7	7
294	Mann	May 6	Oct. 26	13.3	13.2	13.7	7.7	12.7	33.0	8
129	Moyer	May 8	Oct. 10	14.2	14.8	13.7	7.8	13.2	40.8	6
328	Munson	May 7	Aug. 18	10.4	10.3	11.7	11.2	11.4	40.4	4
144	Northern Spy	May 10	Oct. 7	4.5	6.8	9.4	21.9	10.8	33.5	4
145	Northern Spy	May 9	Oct. 6	12.8	15.3	16.8	17.1	16.7	34.2	4
146	Northern Spy	May 10	Oct. 7	3.8	6.7	9.6	17.0	10.0	37.6	7
169	Northern Spy	May 10	Oct. 8	16.9	23.8	24.5	22.6	24.3	63.0	2
176	Northern Spy	May 10	Oct. 8	3.9	10.8	11.5	9.8	11.1	44.0	5
178	Northern Spy	May 10	Oct. 7	16.7	22.2	22.0	10.8	20.5	58.3	4
175	Northwestern (Grng)	May 9	Oct. 20	11.7	15.8	15.7	.....	.....	40.0	3
352	Northwestern (Grng)	May 9	Oct. 20	19.0	24.8	27.7	.....	.....	59.2	1
132	Oldenburg	May 5	Aug. 4	9.0	11.6	12.6	14.2	12.9	30.8	8
133	Oldenburg	May 4	Aug. 4	10.0	14.1	13.2	13.6	13.5	46.2	7
357	Oliver	May 8	Oct. 14	6.9	10.4	12.6	14.7	12.2	42.5	11
323	Paradise	May 7	Oct. 23	11.9	14.8	15.4	14.4	14.7	36.0	4
340	Peck	May 8	Oct. 16	6.4	8.4	10.1	14.6	10.1	29.5	1
239	Ralls	May 13	Oct. 29	12.6	14.1	14.8	13.2	14.3	46.0	2
240	Ralls	May 13	Oct. 29	9.6	12.9	12.6	11.1	12.1	30.0	4
241	Ralls	May 13	Oct. 28	7.9	11.1	10.9	15.6	11.4	34.0	11
334	Rambo	May 7	Oct. 10	11.6	11.4	12.9	15.6	12.8	29.7	6
342	Red Canada	May 8	Oct. 14	8.6	10.8	12.0	7.3	11.4	32.4	5
343	Red Canada	May 8	Oct. 14	11.0	11.0	11.7	9.9	11.4	32.0	7
344	Red Canada	May 7	Oct. 14	14.1	15.6	16.6	13.8	16.1	41.7	7

TABLE 6.—Bloom period and yield of apples.—Continued

Average date of bloom and picking and yield per tree. Trees planted between 1893 and 1899. 33-year record, 1910-1942, inclusive

Tree No.	Variety	Average date		Average annual yield					Highest annual yield	Crop failures
		Full bloom	First picking	1910-1919	1910-1929	1910-1939	1939-1942	1910-1942		
				Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	
227	Rhode Island (Grng)	May 7	Oct. 3	10.1	17.2	19.6	14.0	18.7	55.7	2
229	Rhode Island (Grng)	May 7	Oct. 3	9.9	16.1	22.2	19.4	21.5	56.0	1
324	Rome Beauty	May 10	Oct. 22	13.1	16.6	16.9	20.3	17.1	34.5	0
325	Rome Beauty	May 10	Oct. 22	19.2	20.6	20.2	21.4	20.1	41.0	0
326	Rome Beauty	May 10	Oct. 22	10.9	13.6	14.1	21.6	14.6	33.0	1
101	Roxbury	May 8	Oct. 11	14.8	15.3	16.1	11.9	15.4	40.2	4
224	Salome	May 6	Oct. 26	11.2	16.7	20.6	37.6	22.7	45.0	1
91	Stark	May 6	Oct. 20	10.6	11.4	14.0	16.0	13.8	37.0	2
92	Stark	May 6	Oct. 20	8.4	10.2	12.4	14.8	12.4	34.2	2
121	Stark	May 6	Oct. 20	16.4	14.9	14.9	20.0	15.2	33.6	2
158	Stayman Winesap	May 8	Oct. 23	8.0	12.2	15.2	17.0	15.1	34.8	2
212	Stayman Winesap	May 8	Oct. 22	6.7	6.4	9.4	10.6	9.3	20.2	7
312	Stayman Winesap	May 8	Oct. 24	15.5	13.7	16.3	22.8	16.7	31.8	1
354	Summer King	May 9	Aug. 15	8.5	12.0	15.4	13.2	14.6	51.5	16
219	Tompkins King	May 5	Oct. 2	7.3	9.4	11.1	.....	.....	28.5	1
112	Twenty Ounce	May 8	Oct. 6	5.8	11.6	13.4	18.6	13.9	31.7	2
124	Walbridge	May 7	Oct. 27	8.1	10.3	11.2	11.6	11.2	28.9	2
125	Walbridge	May 7	Oct. 29	9.5	10.2	10.8	15.8	11.2	24.6	2
289	Wealthy	May 8	Aug. 28	6.2	7.6	7.6	9.2	8.0	24.7	9
290	Wealthy	May 7	Aug. 30	6.1	7.6	8.6	6.4	8.4	18.3	1
291	Wealthy	May 8	Aug. 30	5.9	7.8	7.3	9.7	7.8	21.0	10
310	Western Wonder	May 9	Sept. 19	7.8	10.8	12.1	14.8	12.3	40.0	4
88	White Pippin	May 6	Oct. 25	11.4	15.2	17.4	19.8	17.4	55.2	1
89	White Pippin	May 6	Oct. 25	17.2	20.9	22.1	18.4	21.5	57.1	3
90	White Pippin	May 6	Oct. 25	16.0	16.0	17.3	16.4	16.9	40.5	2
259	White Pippin	May 7	Oct. 21	7.6	12.6	15.4	21.3	15.2	47.0	9
100	Winesap	May 8	Oct. 26	6.3	6.8	7.4	.....	.....	17.5	3
266	Winter Banana	May 8	Oct. 10	13.7	14.3	20.3	20.9	19.6	45.0	1
114	Wolf River	May 8	Sept. 19	12.3	13.4	14.8	13.5	14.3	47.0	6
251	Yellow Bellflower	May 7	Oct. 21	5.2	6.8	9.0	9.1	9.1	26.0	2
83	Yellow Transparent	May 7	July 22	8.7	11.5	11.1	9.4	11.0	32.0	9
84	Yellow Transparent	May 7	July 22	9.8	12.2	13.1	19.6	13.8	29.7	7
232	Yellow Transparent	May 7	July 22	6.0	7.4	7.6	.....	.....	20.2	7
111	York Imperial	May 8	Oct. 24	11.3	16.1	19.8	19.1	19.5	42.0	4
309	York Imperial	May 9	Oct. 23	5.0	8.3	8.6	6.2	8.0	32.7	12
Av.	.....	May 8	.....	10.5	12.7	13.8	14.8	13.9	.....	.....

the 33-year period and the date of first picking of each variety are likewise shown. The years in which a tree produced less than a bushel of apples are recorded under the heading "crop failures."

The yield records from the 38 trees which were top-worked from 1904 through 1906 and which were still standing when the orchard was removed were also taken, but, since they frequently included two or more varieties per tree, data from such trees are not included in table 6. Likewise, table 6 yield records do not show the production of the trees which were removed for any cause during the life of the orchard or that of the replacement trees.

The complete production record for the 6.7 acres of orchard from 1910 to 1942 is given in table 7. Yields in this orchard, as a whole, were influenced by such factors as the top-working of the trees during the 1904-1906 period and again in 1912 to 1914 when several trees were top-worked following blight epidemics.

It seems likely that the considerable amount of top-grafting done from 1904 to 1906 tended to lower the production for the orchard as a whole for several years, since, in addition to the top-worked trees which were still standing when the orchard was finally removed, there were many more which were top-worked during the same period but which were subsequently removed.

Beginning about 1920, most of the vacant spaces in the orchard were again filled, so that, as has been previously stated, there was a total of 249 trees standing in the orchard in 1942 out of a 267 spaces. Some spaces were intentionally left vacant to provide sufficient space for some of the large-growing original trees.

The total production of fruit obtained from this 6.7-acre orchard for the 33-year period is probably very similar to what might have been expected in a well-managed commercial orchard having similar soil and site conditions.

When the 61 varieties (table 6) as a whole are considered, the average annual production showed that it was holding rather steady to the last. The average annual yield of some varieties, such as Arkansas and Rome Beauty, were still on an upward trend. Total yield per tree on old trees, of course, is not always a true criterion of possible income, since the quality of the fruit and the cost of production always have to be related to production.

Most of the varieties apparently reached maximum production shortly after the thirty-fifth year and for at least 15 additional years showed no appreciable downward trend in yield.

The average date of full bloom for the entire 61 varieties for the 33-year period was May 8. It has been previously shown (1) that a 20-year record of the date of bloom will be as accurate as one for a longer period.

YIELD PER ACRE

The total annual yields per acre for the entire orchard of 6.7 acres are shown in table 7. These yields include the production from the top-worked trees, as well as from the replants and the original trees. During the earlier part of this period it is possible that some of the production from the top-worked trees may not appear in this table.

The per-acre trend of production in this orchard was gradually upward until 1931, or up to the time when the original trees were 39 years old. The replacements required throughout the life of the orchard produced sufficient

TABLE 7.—Yield per acre from 6.7-acre apple Orchard A at Wooster, Ohio

Planted 1893. Also State-wide production, 33-year period 1910-1942

Year	Orchard A Bushels per acre	Total production of apples in Ohio*	Year	Orchard A Bushels per acre	Total production of apples in Ohio*
		Bu.			*Bu.*
1910	213.2	5,900,000	1927	511.7	5,310,000
1911	136.8	18,700,000	1928	196.3	6,578,000
1912	281.2	10,600,000	1929	505.9	2,592,000
1913	226.7	4,800,000	1930	254.7	4,172,000
1914	289.5	13,300,000	1931	787.9	15,494,000
1915	265.4	17,952,000	1932	358.0	5,512,000
1916	314.4	8,600,000	1933	713.5	4,755,000
1917	258.8	5,760,000	1934	352.8	4,459,000
1918	292.2	7,005,000	1935	705.4	9,016,000
1919	287.5	2,976,000	1936	324.7	3,059,000
1920	304.7	13,213,000	1937	528.2	12,636,000
1921	397.2	3,040,000	1938	248.8	3,565,000
1922	280.0	6,355,000	1939	516.4	†5,800,000
1923	365.6	10,050,000	1940	321.0	†5,074,000
1924	395.3	6,412,000	1941	512.6	†6,000,000
1925	347.6	6,480,000	1942	246.4	†6,384,000
1926	409.4	12,804.000	33-yr. av.	368.2	.....

*Data for 1910-1918 from Yearbook of Agriculture, U. S. D. A.; for 1919-1942 from Bureau of Agricultural Economics, U. S. D. A.

†From 1939-42 the production shown is for commercial crop rather than for total crop.

fruit to keep the average annual yield per acre at a high level up to the end. On the basis of the average annual yield of many of the standard varieties the yield per acre would have been much higher had the entire acreage been planted to a half dozen of the commercial sorts.

One of the interesting things about the data shown in table 7 is the greater fluctuation from year to year in the later years than up to the thirty-fifth year. During the first 35 years there was a general upward trend, but the differences in yields between "high" and "low" crops in alternate years were not so sharp as they were from the thirty-fifth year on. This suggests that many varieties may become more alternate in bearing habit in later years and that there is very little an orchardist can do to correct this tendency.

The total annual production of apples for the entire State for the 33-year period is also shown in table 7.

It will be observed that the production for the State as a whole has been subject to great fluctuation over this period of time. One of the principal reasons for this fluctuation in the State production of apples has been spring frost damage.

In Orchard A frost reduced the crop in 1910, in 1928, and again in 1938. However, even in these years when frost was a contributing factor in the reduction of yield in this orchard, the production per acre in 2 of these years was above 200 bushels and in the other year (1928), 196.3 bushels per acre.

Blossom blight and apple scab reduced the yields two or three times during the 33-year period in Orchard A. No data were secured which would give an indication as to the influence on yield of the sod-mulch soil management followed in this orchard. It seems safe to conclude that this soil management practice was conducive to regular cropping and that the lack of serious frost damage was a major reason for fairly even and satisfactory production over this long period.

EXPERIENCE IN PLANTING REPLACEMENT TREES

During the last 25 years of the life of this orchard, many tree spaces were vacated by the removal of varieties which had proven inferior in quality or susceptible to some tree weakness.

In general, an effort was made to refill these spaces with new varieties. When the replacement trees were planted in the exact location where the old trees had stood, with no special care in planting, the growth of the young trees was generally disappointing and the mortality high.

After a few years' experience in attempting to plant young trees in this old orchard, it became the practice to remove all the soil for a diameter of 3 to 4 feet and to a depth slightly below that of the tree roots of the new tree and to replace this soil with an equal amount hauled in from outside the orchard.

When this plan of replacing the original soil with new was adopted, the young trees made normal growth. From the experience in this orchard, it seems safe to conclude that, where it is necessary to replant young trees in old orchards, the foregoing plan should be followed.

EXPERIENCE IN TRANSPLANTING FOUR-YEAR-OLD STAYMAN WINESAP TREES

In the Spring of 1920, some Stayman Winesap trees which had been planted as year-old trees in a nearby orchard in 1916 were moved to vacant spaces in Orchard A. A sizable quantity of soil was removed with the tree roots from the old location and fresh soil from outside the old orchard was placed around the tree roots of the transplanted trees.

These 4-year-old transplanted trees all survived and made what appeared to be good growth.

In 1941, 22 years after these 4-year-old trees were transplanted, some comparisons in production records were made between these transplanted trees and other Stayman Winesap trees which were set in 1916 and which had remained in the original location. These comparisons are recorded in table 8, along with the production records for some Stayman Winesap trees planted in 1922 in a nearby orchard. In addition to the total yield per tree to and including 1941, the yields per tree in the last 4 years of this period are also shown in the table.

TABLE 8.—Influence of transplanting Stayman Winesap on yields

Year planted	Treatment	Total yield of tree, including crop of 1941	Total yield per tree for 4 years (1938–1941)
		Bushels	*Bushels*
1916	Transplanted in 1920	85.3	28.6
1916	Permanent	143.6	48.8
1922	Permanent	80.1	30.9

The transplanted trees remained vigorous until they were finally removed but they were not quite as large as the trees which were planted in permanent positions in 1916.

It will be noted from the data shown in table 8 that the trees planted in 1922 in an adjacent orchard produced slightly more fruit per tree for the 4-year period ending in 1941 than did the 4-year-old transplanted trees set in 1920.

This would seem to suggest that there is little advantage in setting 4-year-old trees over what might be expected from planting 1-year-old nursery-grown trees.

Hand tools were used when moving trees and the trees were transferred to the new location on a sled. No record was taken of the time or cost of transplanting.

REMOVAL OF ORCHARD A

By the end of the fiftieth season it was evident that this very productive orchard was showing definite indications of decline. Many of the original trees were showing more limb breakage each year. Pruning was becoming more laborious and dangerous, and the quality of the fruit was not as good as it had been earlier. Many of the varieties grown throughout the period had long since demonstrated their inferiority. Since the space was needed for the trial of newer varieties and other projects, it was decided to remove the entire

orchard. About two-thirds of the trees were taken out during the winter of 1942-43 and the remainder, a year later. The report of the removal of this orchard has been recorded elsewhere (4).

Dynamite was required to remove the root systems of the larger trees while a direct tractor hitch was used to pull out the smaller replant trees.

The net cost per acre for removing the old trees, which included sawing the wood into fire-place length and burning the brush of the tops, was $81.19. The cost was reduced somewhat by the sale of firewood.

This site has proven its suitability for an orchard and it seems desirable to put it in shape for replanting as quickly as possible.

After the space had been cleared, 3 tons of ground limestone per acre was applied. The land was plowed and seeded to soybeans. The soybeans were followed by an over-winter cover crop of rye, and the rye, in turn, was followed by sweetclover.

By carefully cover cropping this site, it will be ready for planting to orchard again after an interval of 3 years.

SUMMARY

A 33-year record of yield and date of bloom for 61 varieties of apples are presented.

The grass-mulch system of orchard management for a 44-year period was found to be satisfactory.

The average annual production per acre for the 33-year period was 368.2 bushels.

The importance of site in securing high yields and regularity of production over a long-time period is demonstrated.

Fluctuation in yield from year to year was much less in this orchard than in the State as a whole.

Peak of production for the entire orchard was reached in the thirty-ninth year.

Many varieties were still producing large crops at the end of the fiftieth year.

Production tended to fluctuate more from year to year after the trees reached 35 years of age.

Size of fruit was smaller and the color poorer as the trees grew older.

Many of the larger-growing varieties filled the 33 by 33-foot planting distance by the time the trees were 30 years old.

Cost of removing the trees and clearing the ground ready for plowing at the end of the 50 years was $81.19 per acre.

LITERATURE CITED

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2. Ellenwood, C. W., and T. E. Fowler. 1944. Light and Heavy Pruning Compared with no Pruning of Apples. Ohio Agr. Exp. Sta. Bimo. Bull. 229: 219-227.

3. Ellenwood, C. W., and T. E. Fowler. 1939. Sun-Coloring Apples. Ohio Agr. Exp. Sta. Bimo. Bull. 198: 39-46.

4. Ellenwood, C. W., T. E. Fowler, and J. T. Yoder, Jr. 1943. Removal of Apple Trees. Ohio Agr. Exp. Sta. Spec. Circular 68.

5. Ellenwood, C. W., and J. H. Gourley. 1937. Cultural Systems for the Apple in Ohio. Ohio Agr. Exp. Sta. Bull. 580.

Fig. 1.—Orchard A 18 years from planting.

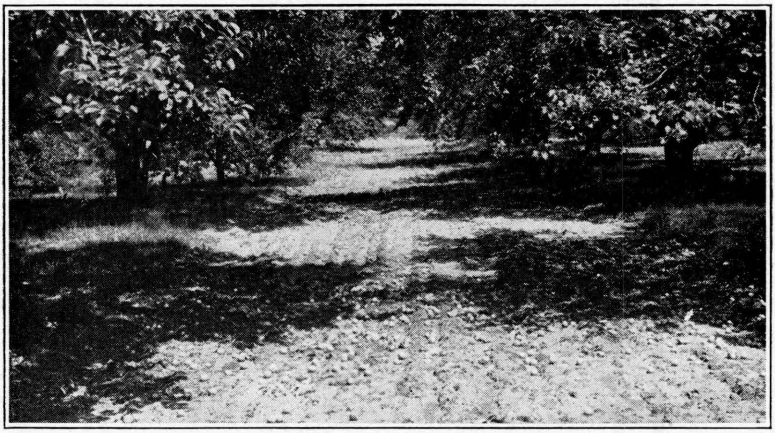

Fig. 2.—Showing area of orchard which was changed from mulch to cultivation after 35 years with no ill effects.

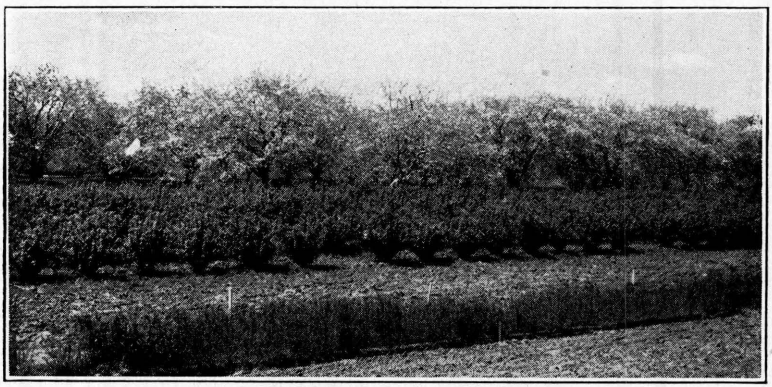

Fig. 3.—Orchard A in the background at 40 years from planting.

Fig. 4.—Orchard A 45 years from planting

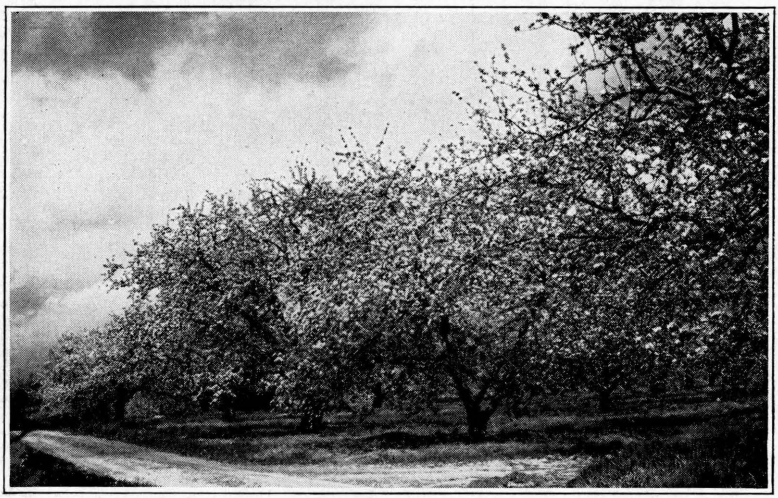

Fig. 5.—Orchard A in full bloom 48 years from planting.

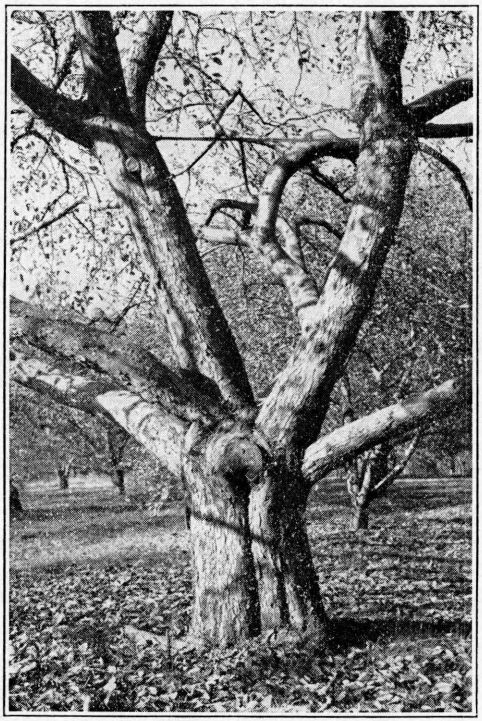

Fig. 6.—Cable bracing of large open-headed tree. Necessary to prevent breakage.

Fig. 7.—Typical open-headed tree, which was in vogue when this orchard was planted, requiring bolt and cable bracing. The modified central-leader type of tree makes a stronger structure.

Fig. 8.—Tree showing cracking following winter injury of 1934-35.

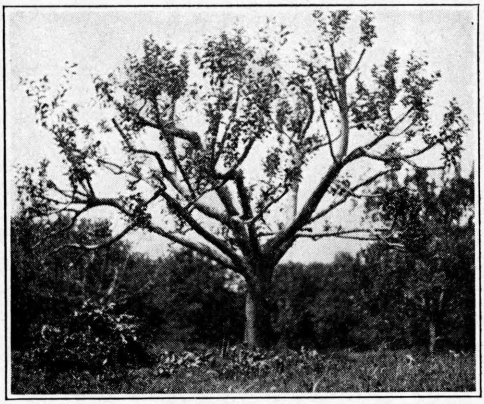

Fig. 9.—Blight-stricken 20-year-old Tolman Sweet, top-worked to Delicious.

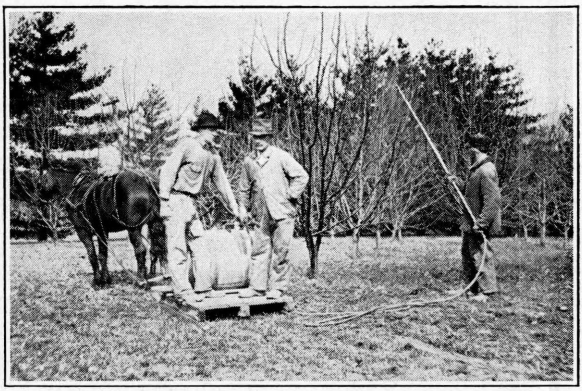

Fig. 10.—Type of hand sprayer in use in 1905-1908

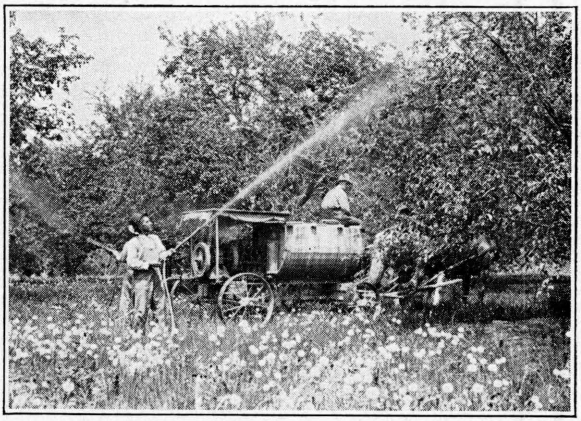

Fig. 11.—Power sprayer in use in 1920

Fig. 12.—Power duster used in 1930.

Fig. 13.—Spraying Orchard A, trees 40 years old. Trees of this size must be sprayed from ground.

Fig. 14.—Sun-coloring. This method is used to improve color of fruit from old trees.

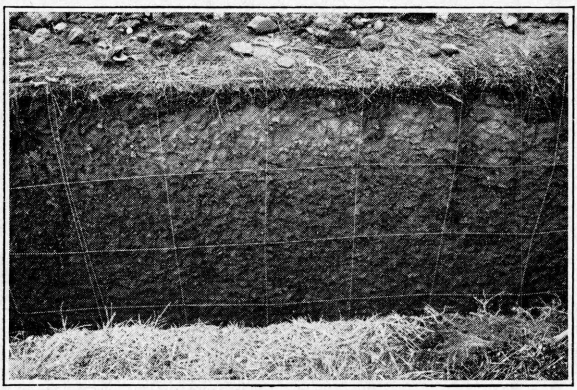

Fig. 15.—Trench used in plotting root development in Orchard A.

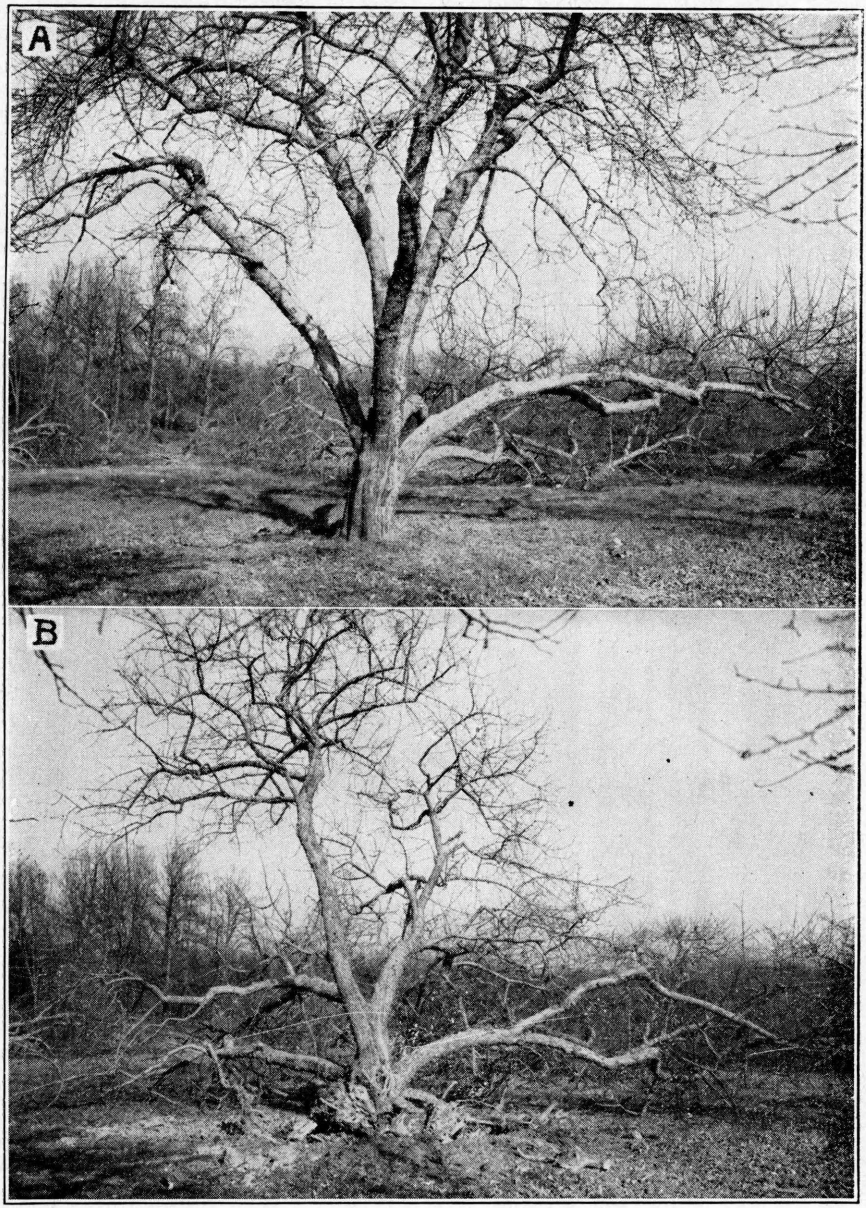

Fig. 16.—A—A sturdy 50-year-old apple tree before dynamiting. Note effect of dynamiting (B).
B—The same 50-year-old apple tree shown in A after 3 pounds of dynamite had been exploded beneath it. The tree is lying on its side ready to be trimmed. Large limbs are used for firewood; brush is burned.

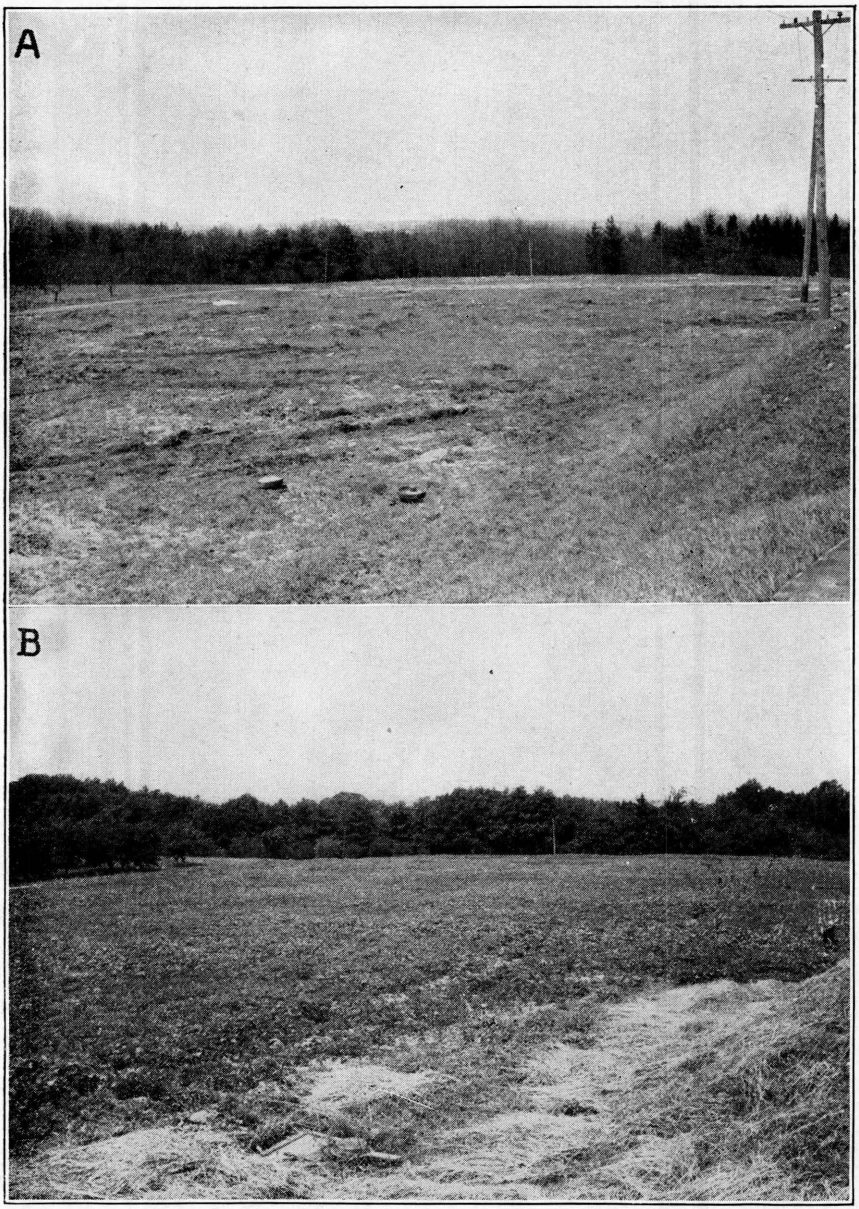

Fig. 17.—A—Showing the orchard area cleared of stumps and roots and ready for plowing.
B—Soybeans growing on area formerly occupied by orchard. Soybeans will be followed by rye for a winter cover crop. With similar soil management for 3 or 4 years this area can again be replanted to orchard.